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Comparisons of Wartime and Peacetime Disease and Non-battle Injury Rates Aboard Ships of the British Royal Navy

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REPORT No. 91-2

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NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
BETHESDA, MARYLAND

COMPARISONS OF WARTIME AND PEACETIME DISEASE AND NON-BATTLE INJURY RATES ABOARD SHIPS OF THE BRITISH ROYAL NAVY

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Report No. 91-2, supported by the Naval Medical Research and Development Command, Department of the Navy, under work unit No. M0095.005-6004. The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of Defense, nor the U.S. Government. Approved for public release, distribution unlimited.

A special note of appreciation is extended to the Royal Navy, Ministry of Defence, and Surgeon Vice Admiral Milton-Thompson for allowing the data of this study to be made available.

SUMMARY

Problem

Medical resource planning requires projections of disease rates expected during combat operations. Peacetime disease and non-battle injury (DNBI) rates have been computed for forces afloat, but no medical records exist for U.S. Navy vessels during the last major naval conflict (World War II).

Objective

The present investigation seeks to contrast disease incidence of British Royal Navy crew members during World War II deployments with illness rates of Royal Navy sailors deployed on peacetime operations. The difference between wartime and peacetime rates will give a measure of the effect of combat on shipboard disease rates.

Approach

Wartime vessels selected for the analyses were all directly involved in combat but were not damaged to the extent that precluded the continuance of their operations. Ships analyzed in peacetime operations were selected from deployments occurring either immediately prior to or directly following the cessation of hostilities. Ship type was also examined as a factor in sick list admission rates.

Results

Illness rates differed among ship types with aircraft carriers having the lowest rates, followed by cruisers, battleships, and destroyers. Comparisons of wartime and peacetime illness rates for carriers, battleships, and cruisers indicated that disease incidence was lower during wartime for all ship types; these differences reached a level of statistical significance for battleships and cruisers. Several specific categories of disorders were significantly lower on wartime deployments than during peacetime operations.

Conclusions

Contrary to illness patterns expected among ground troops, rates of disease among forces afloat were lower during periods of combat than in peacetime. The implication for wartime medical requirements programming is that, aboard ships, peacetime medical resources would need only be supplemented for the expected rate of battle casualties.

COMPARISONS OF WARTIME AND PEACETIME DISEASE AND NON-BATTLE INJURY RATES ABOARD SHIPS OF THE BRITISH ROYAL NAVY

Introduction

Recent investigations have examined the effects of ship size[1] and operational status[2] on the rates of outpatient illness aboard U.S. Navy vessels. These studies indicated that smaller ships (destroyers, frigates) had higher rates of sick bay visits than larger ships (aircraft carriers), and that the rate of outpatient visits was lower among ships providing combat support during the Vietnam conflict than aboard ships in the years immediately following the cessation of hostilities. It was suggested that the lower illness rates on vessels during the Vietnam period resulted from less perceived need for attention to minor medical problems during combat than during peacetime, when the tempo of operations may be greatly reduced.

Medical resource planning requires projections of disease and non-battle injury (DNBI) rates among those persons requiring treatment beyond that normally associated with outpatient visits. Most outpatient visits result in treatment and an immediate return to duty; however, a number of visits will require admission to the sick list—a condition in which the crewmember is sick in quarters rather than returned to duty, while an even smaller percentage of outpatient visits will result in hospital admissions. Accurate predictions of DNBI rates during combat are critical not only for medical requirements programming, but also for manpower planning.

Peacetime hospital admission rates for forces afloat have been computed[3], as have DNBI rates of ground forces serving in Vietnam[4]. However, it is difficult to quantify the effects of combat on rates of illness because no DNBI shipboard medical records currently exist for U.S. forces serving in World War II, the last major naval conflict, nor is there an appropriate control group to compare with the Marines who fought in Southeast Asia. Nevertheless, accurate projections of disease rates during combat are required by the Deployable Medical Systems (DEPMEDS) program[5] to ensure that adequate medical resources are available.

A recent study[6] enumerated several factors potentially contributing to differences in disease rates between peacetime and wartime. These included degree of mobilization, amount of time available for sleep and personal

hygiene, availability of medical treatment, and stress levels. Not only are these factors expected to vary between combat and peacetime settings, but the dynamics may differ considerably between forces afloat and ashore. While the operational tempo during combat may be extremely high aboard ships as well as ashore, the degree of mobilization, distance from medical treatment, and stress levels associated with facing the unknown in unfamiliar territory are likely to be greater among ground troops than among their counterparts providing naval support. Consequently, the impact of combat operations on shipboard disease rates may indeed be different than the impact on land-based troops.

Analyses by Pugh[6] projecting the effect of combat level on disease rates were constrained by the availability of applicable data. U.S. wartime disease records consist of aggregated data for the Navy and Marine Corps, which makes it impossible to accurately assess the effect of combat on forces afloat and ashore separately. However, medical records of shipboard populations of the British Royal Navy immediately before, during, and directly following World War II were found to exist. The goal of the present investigation is to contrast the rates of sick list admissions aboard ships involved in combat with the disease rates occurring aboard ships in peacetime settings. Ship type will first be examined as a factor in disease rates to determine whether the same trend evidenced among the different ship sizes within U.S. forces exists for the Royal Navy. The illness rates of ships participating in combat will be contrasted with similar ships deployed during peacetime to provide a reliable estimate of the effect of high intensity combat on DNBI incidence.

Method

A listing of Royal Navy ships attacked during World War II was obtained from H.M. Ships Sunk or Damaged by Enemy Action[7]. Two criteria were used in selecting ships to be used in the computation of DNBI rates during wartime: 1) that the vessels selected had to be involved in an enemy engagement in the time period under study, and 2) that any damage sustained to the ships involved in the engagements did not preclude it from continuing in action. Medical Officer's Journals (MOJs) archived at the Ministry of Defence at Hayes, Middlesex were examined and records extracted for seven carriers,

three battleships, nine cruisers, and 26 destroyers that were involved in combat between the years of 1940 and 1945. The MOJs were compiled on a quarterly basis and the records used in this study corresponded to three-month periods in which the deployed ships had engaged enemy forces. Each quarterly report contained a tabulation of the numbers and types of illnesses serious enough to require the afflicted crew member to be on the sick list for at least 48 hours.

Similarly, DNBI information was extracted from MOJs for ships deployed immediately preceding the war (1937-38) or following the cessation of hostilities (1946-47). Records from five carriers, two battleships, and thirteen cruisers were extracted from journals maintained during peacetime; no records from individual deployments of destroyers for the years surrounding the war era were available in the archives. Mean ship complements during the quarterly periods were also extracted from the MOJs. Appendix A lists the ships used in the analyses.

Disease and non-battle injury rates were computed as the number of cases per 1000 men per day. Separate rates were computed for the crewmembers aboard carriers, battleships, cruisers, and destroyers during the war, and aboard carriers, battleships, and cruisers in peacetime. For each "ship type by combat status" group, rates were calculated for 23 individual categories of illness. The specific disorders comprised by the illness categories are listed in Appendix B. Confidence limits were computed to determine if the rates differed significantly by ship type and combat status. The Dunn-Bonferroni method of adjusting for multiple comparisons[8] was used in estimating the 95% confidence limits.

Results

Comparisons of sick list admissions between ship types indicated that the DNBI rates differed significantly by type of ship during the wartime deployments. The illness rate aboard aircraft carriers was 0.955 per 1000 men per day, while the rates aboard the other ship types were: battleships, 1.489; cruisers, 1.081; and destroyers: 1.575. The DNBI rates for both carriers and cruisers were significantly lower than the rates aboard battleships and destroyers. Table 1 is a display of the frequencies and rates for illness categories across the ship types. The rate of infectious

disorders was significantly lower on aircraft carriers than on battleships, cruisers, and destroyers. Additionally, the rate of digestive disorders was significantly lower on carriers than on battleships and destroyers. None of the other illness category differences between ship types reached a level of significance.

Because ship type was found to be a factor in rate of sick list admissions, comparisons between wartime and peacetime deployments were done separately for each type of ship. Computation of shipboard DNBI rates for the peacetime deployments indicated that the rates aboard carriers, battleships, and cruisers were all lower during wartime operations than during the periods of peace surrounding the war. Figure 1 is a column chart comparing the illness rates of the wartime and peacetime deploments by ship types.

Table 2 is a presentation of wartime and peacetime illness incidence by the individual disease categories. Aboard carriers, the rates of infectious disorders and parasitic diseases were significantly lower during wartime when compared to peacetime. Among battleships, the rate for skin disorders, as well as the overall DNBI incidence, was significantly lower during combat than on peacetime deployments. Comparisons of individual DNBI categories aboard cruisers indicated that the rate of generative system disorders, skin diseases, and general injuries were significantly lower during wartime deployments than in the periods of peace. The overall DNBI rate aboard cruisers was also significantly lower during the war period than on the peacetime deployments.

Discussion

Previous research had indicated that the rates of outpatient illness aboard U.S. Navy vessels were lower for combat support operations during the Vietnam conflict than in post-conflict periods[2]. The current investigation sought to determine if this finding could be extended to more serious illness conditions than those measured by outpatient visits. The dependent measure in the present study was those DNBI conditions of a severity which warranted a minimum of 48 hours on the sick list. A further distinction between this and the previous study was that combat intensity was at a much

higher level among the afloat combatants in WWII than vessels providing support during Vietnam.

Rates of sick list admissions among ships of the Royal Navy deployed during wartime proved to be lower than those operating in peacetime. This finding applied to aircraft carriers, battleships, and cruisers with the differences reaching a level of statistical significance among the latter two. Though several major differences between this and the previous study exist, a recurring theme was that the rate of illness aboard carriers during war was only marginally lower than in peacetime, while the wartime rates of other ships were significantly lower during the combat deployments. Further, infectious disorder and parasitic disease rates on Royal Navy carriers were significantly lower during wartime when contrasted with peacetime operations, again parallelling a finding among outpatient visits of the Vietnam era study.

Both battleships and cruisers in the Royal Navy had significantly lower rates of skin disorders during combat deployments when contrasted with peacetime rates. Similarly, outpatient visits for skin disorders had been shown to be at significantly lower levels during Vietnam afloat operations than after the conflict. The other two significantly lower rates among disease categories in the present study occurred aboard cruisers for general injuries and generative system disorders. Though previously reported injury rates aboard smaller ships were higher after the Vietnam conflict than during hostilities, these rate differences were not significant; injury rates aboard carriers were in fact significantly higher during Vietnam operations than on post-conflict deployments. There was no illness category corresponding to generative system disorders among the Vietnam era data, so a valid comparison could not be made with that of the Royal Navy.

Among the DNBI rates on the four types of warships investigated during WWII, carriers had the lowest rate of illness overall, and this rate was significantly lower than both battleships and destroyers. A supplemental analysis of Royal Navy data indicated that carriers had significantly lower rates than battleships and cruisers during peacetime, as well. Again, this finding of lower illness rates on carriers than other vessels is consistent with outpatient visit patterns aboard U.S. Navy ships[1]. A likely contributing factor to the lower rates on carriers is the fewer days these ships spend in port when compared with other ships. The large size of

carriers constrains the number of port dockings that these ships can safely maneuver; consequently, crewmembers aboard these vessels do not have as frequent of exposures to the people and conditions in foreign ports that may augment disease transmission and proliferation among their counterparts on smaller ships.

While the sick list admissions in the present study do not represent illnesses which would invariably require hospitalization if occurring ashore, they were of sufficient gravity to subject the afflicted crewmembers to a minimum of 48 hours of bed rest. As such, these illnesses provide a more valid index of disorders impacting the medical resources system than those maladies recorded as outpatient visits. Further, the rates in this study provide a clearer picture of the influence of combat conditions on shipboard disease rates than had previously been reported. That World War II was a high intensity conflict is beyond dispute; the comparisons of these wartime rates with those of peacetime deployments, then, should accurately reflect the potential differences in illness incidence between day-to-day operations and those of worst case battle scenarios.

Though the differences between afloat DNBI rates in wartime and peacetime were generally not great, all types of ships evidenced rate decreases during combat operations. This finding has important implications for medical resource planning. It appears that medical resources for personnel stationed aboard ships during wartime need only be supplemented according to the projected rate of battle casualties. Indeed, a recent study examining non-battle casualties and injuries (NBCI) among peacetime Royal Navy forces surmises that reduced port time among wartime task groups combined with reluctance to report sick during combat may offset the effects of battle stress on illness rates[9].

The validity of generalizing from results based on the Royal Navy to U.S. forces is supported not only by the similar organizational structures and missions of the two navies, but also by parallels between these findings and those from U.S. Navy vessels during the Vietnam era. In both instances, forces afloat met the challenges of combat with no concomitant deleterious effects on the health of the crew members.

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TABLE 1. SICK LIST ADMISSION RATES AMONG SHIP TYPES; ROYAL NAVY, 1940-1945

DISORDERS	CARRIERS		BATTLESHIPS		CRUISERS		DESTROYERS	
	N	RATE	N	RATE	N	RATE	N	RATE
Infections	239	0.278	212	0.580*	276	0.468*	209	0.494*
Parasitic	97	0.113	18	0.049	71	0.120	67	0.158
Nervous System	23	0.027	5	0.014	23	0.039	37	0.087
Eye/Ear/Nose	33	0.038	21	0.057	20	0.034	16	0.038
Circulatory	6	0.007	8	0.022	9	0.015	3	0.007
Blood/Blood Forming	2	0.002	2	0.005	1	0.002	4	0.009
Glandular	1	0.001	0	0.000	0	0.000	0	0.000
Breast	1	0.001	0	0.000	0	0.000	0	0.000
Respiratory	29	0.034	8	0.022	31	0.052	26	0.061
Teeth & Gums	6	0.007	5	0.014	5	0.008	2	0.005
Hernia	6	0.007	4	0.011	3	0.005	6	0.014
Digestive	72	0.084	91	0.249*	72	0.122	94	0.222*
Nutrition/Metabolic	0	0.000	0	0.000	0	0.000	2	0.005
Generative System	19	0.022	17	0.046	6	0.010	12	0.028
Musculoskeletal	33	0.038	12	0.033	16	0.027	16	0.038
Skin	115	0.134	57	0.156	37	0.063	69	0.163
Urinary	5	0.006	4	0.011	4	0.007	7	0.016
Neoplasm	3	0.003	1	0.003	0	0.000	1	0.002
Alcoholism	0	0.000	2	0.005	0	0.000	0	0.000
Poisonings	2	0.002	0	0.000	4	0.007	4	0.009
General Injury	128	0.149	77	0.211	58	0.098	92	0.217
No Diagnoses	0	0.000	0	0.000	2	0.003	0	0.000
TOTAL	**820**	**0.955**	**544**	**1.489*•**	**638**	**1.081**	**667**	**1.575*•**
Mandays	858,519		365,397		590,280		424,432	

* rate is significantly higher than on carriers.
• rate is significantly higher than on cruisers.

TABLE 2. SICK LIST ADMISSION RATES DURING WARTIME AND PEACETIME DEPLOYMENTS

DISORDERS	CARRIERS		BATTLESHIPS		CRUISERS	
	War	Peace	War	Peace	War	Peace
Infections	0.278*	0.433	0.580	0.683	0.468	0.574
Parasitic	0.113*	0.248	0.049	0.076	0.120	0.102
Nervous System	0.027	0.010	0.014	0.015	0.039	0.022
Eye/Ear/Nose	0.038	0.023	0.057	0.071	0.034	0.056
Circulatory	0.007	0.002	0.022	0.031	0.015	0.012
Blood/Blood Forming	0.002	0.008	0.005	0.010	0.002	0.014
Glandular	0.001	0.004	0.000	0.000	0.000	0.000
Breast	0.001	0.000	0.000	0.005	0.000	0.001
Respiratory	0.034	0.030	0.022	0.056	0.052	0.032
Teeth & Gums	0.007	0.000	0.014	0.010	0.008	0.007
Hernia	0.007	0.002	0.011	0.000	0.005	0.003
Digestive	0.084	0.119	0.249	0.285	0.122	0.146
Nutrition/Metabolic	0.000	0.000	0.000	0.000	0.000	0.000
Generative System	0.022	0.040	0.046	0.010	0.010*	0.050
Muscoloskeletal	0.038	0.006	0.033	0.010	0.027	0.022
Skin	0.134	0.094	0.156*	0.372	0.063*	0.186
Urinary	0.006	0.013	0.011	0.020	0.007	0.017
Neoplasm	0.003	0.006	0.003	0.031	0.000	0.004
Alcoholism	0.000	0.000	0.005	0.000	0.000	0.000
Poisonings	0.002	0.002	0.000	0.000	0.007	0.023
General Injury	0.149	0.094	0.211	0.403	0.098*	0.193
No Diagnoses	0.000	0.004	0.000	0.031	0.003	0.006
TOTAL	**0.955**	**1.144**	**1.489***	**2.120**	**1.081***	**1.471**
Mandays	858,519	470,250	365,397	196,200	590,280	693,228

* rate was significantly lower during wartime operations than on peacetime deployments.

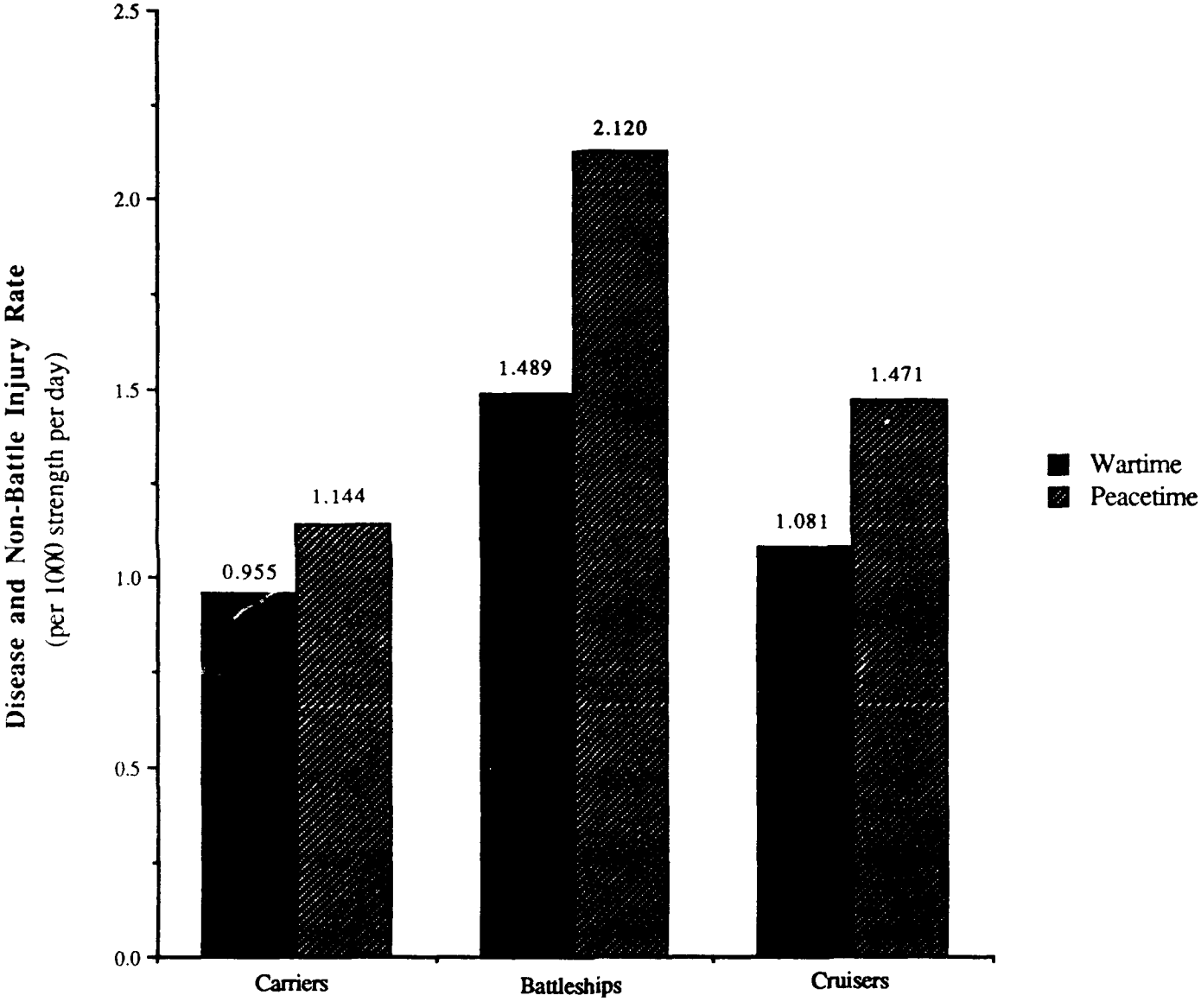

Fig. 1. Disease and Non-Battle Injury Sick List Admission Rates by Deployment Status and Ship Type; British Royal Navy

APPENDIX A

SHIPS OF WARTIME AND PEACETIME DEPLOYMENTS

Wartime	Peacetime
Carriers	**Carriers**
Formidable	Formidable
Furious	Furious
Illustrious	Illustrious
Indomitable	Indomitable
Pegasus	Victorious
Victorious	
Battleships	**Battleships**
Malaya	Malaya
Rodney	Rodney
Valient	
Cruisers	**Cruisers**
Argonaut	Arethusa
Aurora	Argonaut
Berwick	Aurora
Cleopatra	Berwick
Enterprise	Birmingham
Kenya	Cleopatra
Mauritius	Enterprise
Sirius	Kenya
Sussex	Mauritius
	Orion
	Penelope
	Sirius
	Sussex

Destroyers

Albrighton	Ledbury
Anthony	Liddesdale
Beaufurt	Lively
Bulldog	Nubian
Cleveland	Obedient
Diamond	Quality
Fame	Quillian
Firedrake	Quorn
Griffin	Ripley
Hero	Southdown
Jackal	Windsor
Kimberley	Zambesi
Lamberton	

APPENDIX B

DISEASE CATEGORIES AND SPECIFIC DISORDERS WITHIN EACH CATEGORY

INFECTIONS
- Chicken Pox
- Common Cold
- Cow Pox
- Dengue
- Diptheria
- Dysentery
- Enteric Fever, Typhoid
- Enteric Fever, Paratyphoid
- Erysipelas
- Influenza
- Malaria
- Measles
- Meningococcal Infection
- Mumps
- Pneumococcal Infection (lungs)
- Pneumococcal Infection (other)
- Pyogenic Infection
- Pyrexia of Unknown Origin
- Rheumatic Fever
- Rheumatism, sub-acute
- Rubella
- Sandfly Fever
- Scarlet Fever
- Small-pox
- Tonsillitis
- Tuberculosis (pulmonary)
- Tuberculosis (non-pulmonary)
- Undulant Fever
- Chancroid
- Chancroid Sequelae
- Syphillis (first record)
- Syphillis (later record)
- Gonococcal Infection, acute
- Gonococcal Infection, sequelae
- Lymphogranuloma, inquinale
- Other diseases caused by Infection

DISEASES CAUSED BY METAZOAN PARASITES

DISEASES OF THE NERVOUS SYSTEM
- Diseases of Spinal Cord
- Diseases of Brain
- Apoplexy
- Paralysis
- Epilepsy
- Neurasthenia
- Other Nervous Diseases (including Mental)

DISEASES OF THE EYE

DISEASES OF THE EAR

DISEASES OF THE NOSE

DISEASES OF THE CIRCULATORY SYSTEM
- Diseases of the Heart (Organic)
- Diseases of the Heart (Functional)
- Diseases of the Arteries
- Diseases of the Veins

DISEASES OF THE BLOOD AND BLOOD-FORMING ORGANS
DISEASES OF GLANDS AND INTERNAL SECRETION
DISEASES OF THE BREAST
DISEASES OF THE RESPIRATORY SYSTEM
- Diseases of the Larynx
- Bronchial Catarrh
- Bronchitis
- Asthma
- Fibrosis of Lung
- Pleurisy
- Other Respiratory Diseases

DISEASES OF TEETH AND GUMS
HERNIA
- Hernia Recurrent

DISEASES OF THE DIGESTIVE SYSTEM
- Mouth, Palate, Fauces, Pharynx
- Peptic Ulcer, Gastric
- Peptic Ulcer, Duodenal
- Appendicitis
- Other Diseases of the Stomach
- Other Diseases of the Intestines
- Diseases of the Rectum and Anus
- Diseases of the Liver
- Other Digestive Diseases

DISEASES OF NUTRITION OR METABOLISM
- Scurvy
- Beri-Beri
- Gout
- Diabetes
- Other Diseases of Nutrition

DISEASES OF GENERATIVE SYSTEM
- Stricture
- Varicocele
- Orchitis
- Other Diseases of Generative System

DISEASES OF BONES, JOINTS, MUSCLES, FASCIAE, AND BURSAE
- Periosteum and Bone
- Cartilage and Joints
- Spine
- Muscles, Fasciae, Tendons, Bursae
- Deforities and Congenital Malformations

DISEASES OF AREOLAR TISSUE AND SKIN
- Abscess
- Boil
- Eczema
- Impetigo
- Other Diseases of Areolar Tissue and Skin

DISEASES OF URINARY ORGANS
- Kidneys
- Ureter and Bladder
- Urinary Disorders

NEOPLASMS
- New Growths, Malignant
- New Growths, Non-malignant

ALCOHOLISM

POISONING, VARIOUS

GENERAL INJURIES
- Multiple Injuries
- Multiple Burns and Scalds
- Heat Stroke
- Suffocation-Drowning
- Suffocation, -effects of
- Compressed Air Disease
- Burns and Scalds
- Injuries and Wounds

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS N/A
2a. SECURITY CLASSIFICATION AUTHORITY N/A	3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE N/A	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) Report No. 91-2	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Naval Health Research Center 6b. OFFICE SYMBOL (*If applicable*)	7a. NAME OF MONITORING ORGANIZATION Chief, Bureau of Medicine and Surgery
6c. ADDRESS (*City, State, and ZIP Code*) P. O. Box 85122 San Diego, CA 92186-5122	7b. ADDRESS (*City, State, and ZIP Code*) Navy Department Washington, DC 20372-5120
8a. NAME OF FUNDING / SPONSORING ORGANIZATION Naval Medical Research & Development Command 8b. OFFICE SYMBOL (*If applicable*)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (*City, State, and ZIP Code*) NNMC Bethesda, MD 20889-5044	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 63706N; PROJECT NO. M0095; TASK NO .005; WORK UNIT ACCESSION NO. DN249506

11 TITLE (*Include Security Classification*)
(U) COMPARISONS OF WARTIME AND PEACETIME DISEASE AND NON-BATTLE INJURY RATES ABOARD SHIPS OF THE BRITISH ROYAL NAVY

12 PERSONAL AUTHOR(S)
Blood, C. G.; Pugh, W. M.; Pearsall, D. M.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (*Year, Month, Day*)	15. PAGE COUNT
Final	FROM _____ TO _____	1991 June	17

16 SUPPLEMENTARY NOTATION

17 COSATI CODES		
FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (*Continue on reverse if necessary and identify by block number*)
Disease and non-battle injuries, Shipboard illness rates
Wartime disease incidence, British Royal Navy

19 ABSTRACT (*Continue on reverse if necessary and identify by block number*)
Disease and non-battle injury rates were computed for ships of the British Royal Navy which were deployed during wartime and peacetime operations. The wartime sick list admission rates were lower aboard carriers, battleships, and cruisers when compared with their counterparts deployed in peacetime. The illness rate differences for battleships and cruisers were statistically significant. Several categories of disease also yielded significant differences in the wartime/peacetime contrasts. Illness rates varied by ship type, with the lowest rates evidenced aboard carriers.

20 DISTRIBUTION / AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT ☐ DTIC USERS	21 ABSTRACT SECURITY CLASSIFICATION Unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL C. G. BLOOD	22b TELEPHONE (*Include Area Code*) 619-553-8393; 22c OFFICE SYMBOL CODE 20

★U.S. Government Printing Office: 1988—607-047